

Overview of EPA Office of Research and Development Lead (Pb) Science

Valerie Zartarian, Ph.D.

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Acknowledgments

Multimedia exposure-dose Pb modeling:

- Jianping Xue, Rogelio Tornero-Velez, James Brown, Lindsay Stanek, Jay Garland

Drinking water Pb control

- Darren Lytle, Mike Schock, Sandhya Parshionikar, Regan Murray, Thomas Speth

Other Pb technical assistance & contaminated sites

- Karen Bradham, David Thomas, Kirk Scheckel, Myriam Medina-Vera
- James Brown, Ellen Kirrane

ORD Labs, Centers, Offices; National Research Programs; IOAA

EPA Technical Review Workgroup (TRW) for Lead

Collaborators across EPA and with other agencies

Outline

- a) Multimedia Pb modeling
- b) Drinking water Pb control
- c) Other Pb technical assistance & contaminated sites

Innovative Multimedia Exposure-Dose Pb Modeling

Problem: Estimate children's blood lead levels (BLLs) for the U.S. residential population, given multimedia exposures from drinking water, soil, dust, air, and food

Stakeholders: EPA Office of Water and other Program Offices, public health community

Approach:

- ✓ Probabilistic analysis using coupled EPA's SHEDS-Multimedia and IEUBK models
- ✓ Model evaluation using CDC NHANES BLLs data
- ✓ Determined relationship between daily average drinking water Pb concentrations & BLLs for specified scenarios
- ✓ Quantified relative exposure pathway contributions across population distributions
- ✓ Identified most important factors affecting BLLs

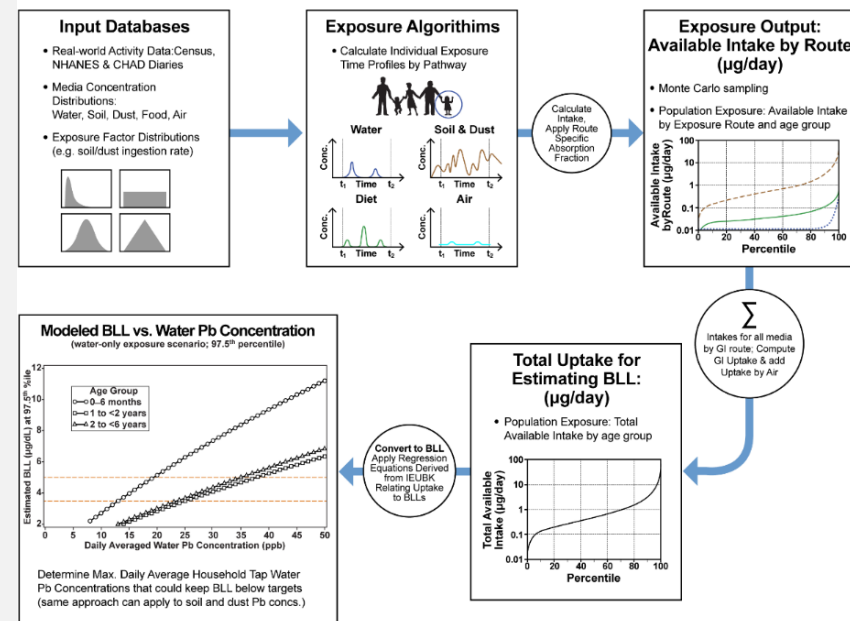
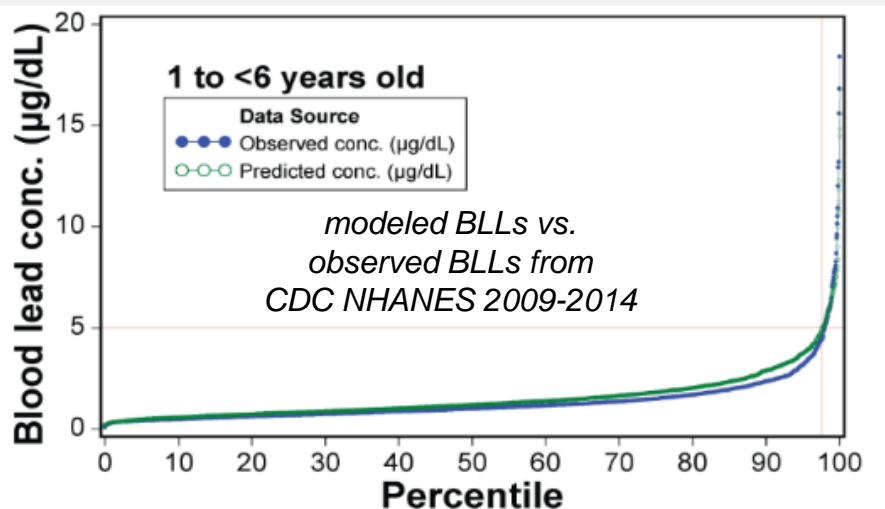


Figure 1,
V.G. Zartarian, J. Xue, R. Tornero-Velez, J. Brown, 2017, *Environmental Health Perspectives*, DOI number: 10.1289/EHP1605.

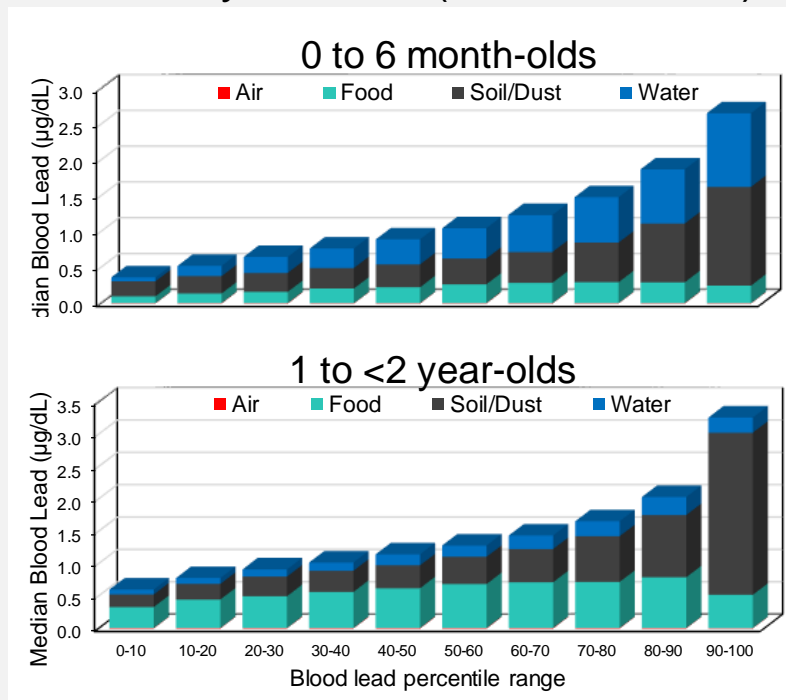
Multimedia Exposure-Dose Modeling (cont'd)

Results:

Model Evaluation



Estimated Contribution of Exposure Pathways to BLL (national scale)



Impact:

- Provides a strong scientific basis to inform potential health-based Pb decisions
- Advances science of probabilistic Pb modeling and understanding of key pathways and factors
- Highly accessed journal article in *Environmental Health Perspectives*, Sept 2017, vol 125(9)
<https://doi.org/10.1289/EHP1605>

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Flint, MI Emergency Response

Problem: Corrosion control issues led to high levels of Pb in drinking water

Stakeholders: Flint community, MI DEQ, EPA Region 5

Actions: ORD technical assistance:

- ✓ Analyzing Pb pipe scales
- ✓ Detecting Pb service lines
- ✓ Distribution system monitoring, modeling, mapping
- ✓ Assessing corrosion control treatment
- ✓ Analyzing drinking water Pb concentration data over time
- ✓ Mapping publicly available sociodemographic, house age, water Pb data



Results: Recommendations for rapidly implementable actions for Pb mitigation and improved drinking water quality

Impact: Flint has implemented robust and sustainable drinking water treatment monitoring and distribution practices recommended by EPA.



Corrosion Control Support for States and Utilities



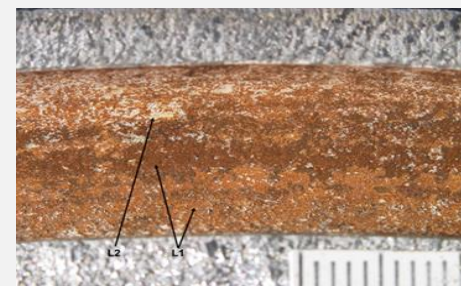
Problem: Communities need technical assistance related to corrosion control and action level exceedances

Stakeholder: Regions, states, drinking water utilities

Actions: ORD diagnosed distribution system issues, performed scale analysis, analyzed sampling data, and recommended corrosion control treatment approaches

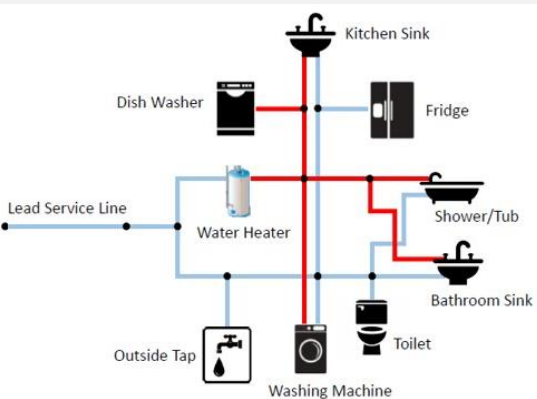
Results:

- Helped Providence, RI choose an innovative use of orthophosphate at elevated pH as their treatment
- Supported Sebring, OH and Ohio EPA in resolving treatment/monitoring questions for elevated Pb problem
- Diagnosed and recommended water treatment processes that solved copper corrosion issues at Wright Patterson Air Force Base and Indian Hill, OH



Impact: Through ORD's site-specific support and recommendations, states & water systems around U.S. have improved drinking water quality, including Pb reductions.

Innovative Water Lead Research



Problem: Pb sampling techniques were not designed to measure Pb levels for human exposure estimation; models need to incorporate complex plumbing layouts

Stakeholders: Regions, states, drinking water utilities, public health community

Actions: Conduct water Pb sampling research and model development studies to estimate Pb exposures

Results:

- Invented a new patent pending automated sampling technology, the Lead Exposure Assessment Device, a composite sampler that can inform estimates of Pb exposure within a home and potentially also be used to identify lead service lines
- Developed a prototype extension of EPANET to model fate and transport of lead in premise plumbing



Impact: Can improve estimates of Pb in drinking water, human exposures, and blood lead levels that can inform risk reduction efforts.

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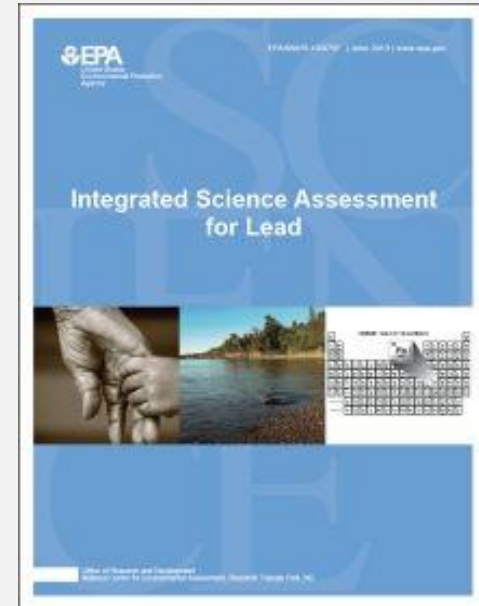
Integrated Science Assessment for Lead

Problem: Identify critical human health and welfare effects of Pb exposure to inform policy options and EPA decisions on standards

Stakeholders: Office of Air for ISA; ORD provides ongoing support to a number of stakeholders

Approach: Systematic review of ~ 1500 health and ~ 700 ecological effects studies by ORD

Product: Integrated Science Assessment (ISA) for Lead (EPA/600R-10/075F/June 2013)



Impact: The Lead ISA (previously the Air Quality Criteria Document) is the scientific foundation for the Lead National Ambient Air Quality Standard (NAAQS) and has been used to support other EPA decisions.

CASAC 4/10/2012: *“the country looks to you [the U.S. EPA] for the current assessment on the science about lead. And the world looks at this country, so this is an important document.”*

Omaha Pb Superfund Site

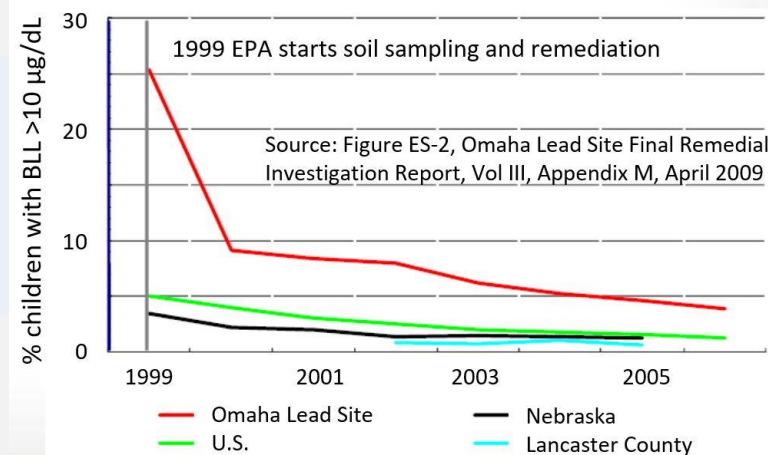
Problem: Assess efficacy of soil remediation with respect to health outcomes

Stakeholders: Region 7, the Douglas County Health Department, Nebraska Department of Health and Human Services, Omaha Public Schools

Approach: ORD collaborated with stakeholders to compile data linking soil and dust lead concentrations and mitigation actions to children's blood lead levels (BLLs) and achievement.

Results: Preliminary analyses show mean BLL of children on the Omaha site decreased to the levels of other children in the county by 2012; however, upper percentile BLLs remain somewhat elevated

Impact: Soil remediation effectively reduced children's BLLs. This study will improve understanding of factors affecting BLLs at Superfund sites.



Innovative Soil Testing Methods

Problem: Site specific Pb bioaccessibility is a critical factor in setting clean up levels and determining cost of cleanup. Established methods to estimate this have been very expensive and time consuming.

Stakeholders: EPA Regions 1-10, Program Offices (OLEM and ORCR), States, and Communities

Approach: ORD – OLEM collaboration to develop reliable and inexpensive *in vivo* (rodent) and *in vitro* models for assessing the bioaccessibility of Pb in contaminated soils

Results: ORD provided a rapid, validated, inexpensive standard bioaccessibility method for use in setting site specific cleanup levels

Impact: EPA's use of site-specific values for Pb risk assessments protects public health in communities across the U.S. and saves hundreds of millions of \$ in cleanup costs.

